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ENGINEERING AND EQUIPMENT

No. 72

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USSR REPORT

ENGINEERING AND EQUIPMENT

No. 72

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MARINE AND SHIPBUILDING

UDC 629.123.03"313"

DEVELOPMENT OF POWER PLANTS FOR CARGO VESSELS BY THE YEAR 2000

Leningrad SUDOSTROYENIYE in Russian No 10, Oct 80 pp 19-21

DUSHIN, Yu. K.

[Abstract] The development of power plants to meet the requirements of a cargo fleet by the year 2000 will be characterized by a trend toward a higher fuel economy combined with ab adaptation to synthetic liquid and gaseous fuels produced from lower-grade raw materials. Most preferable now are diesel power plants and further improvements in their performance are anticipated. Steam-turbine power plants are less desirable for use on vessels now, but their better adaptability to lower-grade fuels will make them more competitive in the future. Gas-turbine power plants offer the best performance characteristics, although they require higher-grade fuels, and should be particularly suitable for high-speed surface or underwater hydrofoils fueled with hydrogen. Atomic power plants are excellent for very long service without refueling, ideal for icebreakers and arctic expeditions. Although a water-moderated water cooled 2-loop reactor is and will remain the basic version, a single-loop helium coded reactor will also be considered. Other unconventional power plants considered for vessels in the future are those involving MHD, thermoelectric, electrochemical energy conversion, but most intensive developments during the 1980-2000 period are foreseen in conventional power plants. Table 1; references 11: 8 Russian, 3 Western.
[113A-2415]

UDC 629.12-52"313"

AUTOMATION OF SHIPBOARD EQUIPMENT FOR THE BEGINNING OF THE TWENTY-FIRST CENTURY

Leningrad SUDOSTROYENIYE in Russian No 10, Oct 80 pp 25-30

YUNG, V. N.

[Abstract] Automation of shipboard equipment is expected to be in use until the year 2000 vessels operating with diesel and gas-turbine power, and only after that also vessels operating with atomic power - following a sharp trend then toward conversion to breeder reactors using uranium-238 and thorium as fuel. Developments and improvements in automation, which must keep in step with these trends, are

based on improved construction and extended uses of digital microcomputer systems. They should eventually lead to automatic operation, inspection, and maintenance of equipment without shutdown and including particularly complex starting and running of atomic power plants. Television and magnetic tape recording are the likely two major media of communication and control, direct or via a master station or via satellite. Figures 3; references 6: 4 Russian, 2 Western.
[113A-2415]

CONSTRUCTION

UDC 621.643.002.2/551.481.2

BALLASTING OF PIPELINES UNDER CONDITIONS OF THE FAR NORTH

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 10, Oct 80 pp 23-25

BLINOV, M. A., Construction Segment SU-11, Northern Pipeline Construction Trust, Nadym

[Abstract] The climatic conditions in the northern marsh and wetlands of Tyumenskaya Oblast (Western Siberia) require speedy pipeline construction, especially ballasting and anchoring of the conduits. Innovative engineering and management have made it possible to reliably and economically install as much as 1-1.2 km of pipeline in one day. The contributing factors include a well trained fast working crew, tool and repair shop facilities available around the clock, with adequate communication and transportation, and application of modern technology. Use of expanding AR-401 anchors and drilling of leader holes with a BM-802 boring machine speeds up the operation by 0.5 km per work shift and reduces the earth moving volume by 50%. A special thermal anchor with shock absorbers is used in permafrost ground. Another feature is the use of cross beams with UBO counterweights for reliable ballasting, two of them installed simultaneously. Pads thermally insulating the ground from the pipe conduit laid in it further enhance the reliability of anchors and result in a saving of approximately 500 thousand rubles per km of pipeline. Use of a rotary trench excavator for anchoring in permafrost should contribute additional savings. All these techniques have already been implemented by the crews under the directorship of A. D. SANTYUROV and A. D. FATULAYEV.
[114-2415]

UDC 621.643.002.2

INSTALLATION OF A CONDUIT IN A PIPELINE DUCT WITH A 1220 MM DIAMETER

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 10, Oct 80 pp 33-34

EDEL', G. V., Special Design Office for Gas Pipeline Construction and Machinery, TEN, K. A. and AKASHEV, V. G., Trust of Engineering Construction Organization, Rostov-on-the-Don

[Abstract] A conduit at least 3 km long for an oil pipeline had to be laid in an underground duct whose dimensional restrictions did not permit the use of

conventional technology and equipment. The problem was solved by means of dollies: four 4-wheel dollies for transporting the conduit to the site on narrow tracks and six 8-wheel dollies for lifting and supporting it. With a movable work bench on a dolly, some welding operations were performed first outside the duct and other necessary splicing operations then inside the duct. The conduit was pulled into the duct by proper coordination of the 8-wheel dollies. This procedure resulted in a maximum mechanization of assembly work inside the duct, with the minimum number of necessary joints. Figures 2.
[116-2415]

INDUSTRIAL TECHNOLOGY

UDC 621.951.1.047.7

ELECTROCHEMICAL DRILLING

Moscow MASHINOSTROITEL' in Russian No 10, Oct 80 p 25

NAZAROV, N. V.

[Abstract] Electrochemical drilling of holes in engine fuel and lubrication systems eliminates burrs and sharp edges as well as chips which could easily contaminate the fuel or the lubricant. A special-purpose electrochemical drill has been developed which is small enough for insertion inside a pipe and is particularly suitable for operation inside pipes with welded fittings. The electrode slides into one end of the hollow shaft, which is also threaded and coupled to a clutch and through a pinion to a gear motor. The shaft with the electrode rotates during drilling, supported in the housing by sleeve bearings. The workpiece is fastened to the housing facing the electrode tip, the electrolyte is fed through this hollow shaft from the other end of the housing. Rotation of the electrode during its axial forward motion ensures high precision of the drilling process. Stabilization of the process requires that the gap between electrode tip and work surface be such that the rate of metal dissolution becomes equal to the rate of electrolyte feed. The latter is not critical, however, inasmuch as the process is a contactless one. The electrode, in effect, converts the pressure head of the electrolyte to an equivalent velocity head. Various details have been included for better control and reliability of the operation. Figures 3.
[115-2415]

UDC 621.787:621.9.048.4

EQUIPMENT FOR HARDENING A TOOL

Moscow MASHINOSTROITEL' in Russian No 10, Oct 80 pp 24-25

MARTYNOV, I. N. and RUDENKO, I. A.

[Abstract] A new model EFI-78 of electrical hardening equipment for tools made of high-speed steels which ensures searless treatment at nine possible levels, by appropriate current settings within the 1-10 A range. Electrodes of graphite, copper graphite, or VK6 and VK3M alloys can be used, replacement and repair

requiring no special facilities. The equipment is designed for hardening drill bits, a variety of milling cutters, gear cutters, planers, reamers, dies and punches. Preliminary experience in the "Svet Shakhtera" production plant in Kharkov and at the "October Semicentennial" machine manufacturing plant in Novokaragandinsk indicates ≈ 50% improvement in productivity over the old EFI-45,46,46A models. Tables 1.
[115-2415]

UDC 621.914.32-115

MACHINING OF INTERNAL SURFACES OF LARGE RADII

Moscow MASHINOSTROITEL' in Russian No 10, Oct 80 p 26

KONDRAT'YEV, V. N. and KACHNOV, Yu. P.

[Abstract] A general-purpose vertical milling machine is used for planing of surfaces by method much simpler and less expensive than special tables or direct digital control. This method is based on the premise that a surface concavity produced by a cutter head not quite perpendicular to the surface has an elliptical shape, the semimajor axis equal to half the cutter diameter and the semiminor axis equal to the latter times the sine of the rake angle. It has been found that, by adjusting the angle of the cutter head, one can produce a surface of a desired large radius over a certain limited width. The cutter width must not exceed about 40% of the cutter diameter, however. A class-5 surface finish of surfaces with 300 mm or larger radii can thus be attained with 63-400 mm (diameter) milling cutters. Figures 2.
[115-2415]

UDC 62-222-85-82

A PNEUMOHYDRAULIC CYLINDER

Moscow MASHINOSTROITEL' in Russian No 10, Oct 80 p 29

DOTSENKO, V. A.

[Abstract] A pneumohydraulic cylinder has been developed at the Zhdanov branch of the "Pochvomash" Design Engineering and Technological Institute which features a uniform velocity of piston movement throughout the entire travel for driving a centrifuge. It contains a center piston with the connecting rod, a guide bushing for the latter, a ring piston, a sleeve separating both pistons, two oil plugs and a throttle valve. Eash piston is alternately pushed by compressed air against oil, which in turn pushes the other cylinder in the opposite direction. The volume of the oil cavity behind the ring piston must be larger than the volume of the air cavity before the center piston so as to ensure compensation of possible

oil loss and thus a full travel of the center (main) piston. This cylinder replaces a plain hydraulic cylinder with a pump. Figure 1.
[115-2415]

UDC 621.838.216

A FREE-RUNNING CLUTCH

Moscow MASHINOSTROITEL' in Russian No 10, Oct 80 p 33

KOTEL'NIKOV, V. A.

[Abstract] A clutch has been invented (USSR Patent Disclosure No 505,838) for torque transmission in one direction only and free running in reverse which differs from conventional ratchet clutches in that it uses permanent magnets instead of detents for limiting the engagement of the claws. A spring opposes the pull of each magnet as well as friction and the centrifugal force. The sliding motion reduces the number of impacts between claws and teeth, which extends the life of the clutch appreciably. This clutch can be used for starting a gas turbine engine and disconnecting it from the starter after a certain speed has been reached. Figure 1.
[115-2415]

UDC [007.52:551.46.077]"313"

UNDERWATER ROBOTS OF THE FUTURE

Leningrad SUDOSTROYENIYE in Russian No 10, Oct 80 pp 15-18

POPOV, Ye. P. and PIS'MENNYY, G. V.

[Abstract] Replacement of human divers with microcomputer-controlled robots should greatly enhance deep-water and offshore oceanographic research not only economically but also technically. One advantage of robots is their universality, only a few different types are needed for covering a wide range of operations. The modular principle should be applied here to their design and construction, with fully automatic or semiautomatic control or with direct man-machine interaction. By the year 2000 one can very well find the sea bottom thoroughly explored for oil deposits and the oil extracted through underwater pipelines, with robots playing an important role in all operations. Various modes of operation are possible involving a master ship, a robot, and sensors installed throughout the area. The main three problems in developing such systems are: 1) adequate supply of electric power either from a remote source through cables or from a local chemical source with sea water serving as the electrolyte; 2) an adequately efficient and sensitive system of control signals transmission to the robot; 3) and adequate channel capacity and interference immunity for data transmission to the ship.

Underwater communication is possible over conventional coaxial cable pairs, over cables with optical glass fibers, over a hydroacoustic channel, or over a laser channel. Digital data transmission with adaptive delta modulation appears to be most efficient with the highest degree of interference immunity under water, but requires encoding and decoding systems. A computer system for underwater operations will have to have a hierarchical multiloop structure including two digital machines: a microcomputer installed in the robot and a minicomputer with a large memory installed on the ship. Figures 7; references 3: 2 Russian, 1 Western.
[113A-2415]

UDC (334,763:621.396.6):629.12"313"

REQUIREMENTS FOR THE LAYOUT OF NAVIGATION INSTRUMENT MANUFACTURING PLANTS

Leningrad SUDOSTROYENIYE in Russian No 10, Oct 80 pp 37-38

KASHIN, N. V. and TERESHCHENKO, A. A.

[Abstract] Manufacturing plants built in the next two decades for the production of radioelectronic navigation instruments will have to be laid out so as to accommodate the technological trends of the future. Although only 5% more new special-purpose microelectronic devices are expected to be found in use by the year 2000, most of them produced by thin-film technologies, there will be an extended application for surface-acoustic-wave, optoelectronic and cylindrical-magnetic-domain devices. Both high product quality and high plant productivity will be made possible by better mechanization and automation of facilities, with digital programmed control where applicable, by incorporation of dust abatement equipment for holding the contamination level below 0.1-0.15 mg/m^3, by incorporation of latest assembly and testing facilities such as printed-circuit lines, contactless inspection with laser beams, evacuation, gas filling, and hermetization, by providing stockroom facilities for parts and materials as well as storage facilities for finished products, and by making available the services of engineers and scientists for research and support activities with appropriate laboratory, computer and other facilities. The factory space is expected to increase by 50-100% per plant employee during the 1990-2000 period, with proper attention also paid to production hygiene and occupational health maintenance.
[113A-2415]

UDC 629.128"313"

SHIPYARDS OF THE FUTURE

Leningrad SUDOSTROYENIYE in Russian No 10, Oct 80 pp 43-48

IVANOV, Yu. P.

[Abstract] The main trend in shipbuilding organization and technology is a more intensive mechanization and automation of shipyard facilities, which should take this industry out of the 1978-1985 crisis characterized by a worldwide lag of production behind demand. Technical and economic considerations dictate that only ships of types and sizes be built which will not require changing the basic production characteristics of shipyards. One major problem in shipbuilding is an imbalance in the technical level of hull assembly, inherent to the sectional method used and the complexity of processes involved. Two possible schemes for solving this problem by standardization are suggested. One is using full-height or full-width bulk, semibulk and flat structural segments, with the ship "moving" from one assembly station to the next or with the assembly stations "moving" along the ship. The second scheme is progressive lengthwise buildup of the hull with modules which cover the entire cross section. Wharf layouts for both schemes of hull assembly are shown, each providing room for adequate power supply and, most importantly, the necessary welding equipment. Each includes a shed for protection of the crew against adverse weather conditions which will save up to 10% of total labor time lost because of human discomfort. Operations in a covered shipyard will, however, require means of moving and transporting without the use of cranes. Figures 2; references 6 Western.
[113A-2415]

UDC 007.52:629.12.002

INDUSTRIAL ROBOTS IN SHIPBUILDING

Leningrad SUDOSTROYENIYE in Russian No 10, Oct 80 pp 48-50

LUR'YE, I. Yu.

[Abstract] Over thirty different types of robots have already been developed in the Soviet Union, including a general-purpose "universal" one and several for heavy or light metal forming and fabrication processes. They can handle objects weighing up to 400 kg and measuring up to 5 m. There are also available the U.S. "UNIMATE" and the Japanese "ROTAS". Adaptation and use of these robots for shipbuilding, where objects weighing up to 2.7 tons must be handled, requires a sound economic analysis of the cost of operation versus the savings through productivity and quality over one and two five-year periods. Their application here must necessarily be selective and will, furthermore, require a most rational automation of the production process with the possibility of controlling several robots from a single computer. Figures 1; references 7: 6 Russian, 1 Western.
[113A-2415]

UDC 621.438

AN END COOLER FOR A CLOSED-CYCLE GAS TURBINE INSTALLATION WITH AN AIR TURBINE CIRCULATOR

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian
No 9, 1980 pp 74-76

IVANOV, V. L., candidate of technical sciences, assistant professor, and YANSON, R.A., candidate of technical sciences, assistant professor

[Abstract] A closed-cycle gas turbine engine is discussed in which the air is drawn through the cooling heat exchanger by an air compressor which is driven by an air turbine operated by the energy of the air heated in the heat exchanger itself. This produces a binary cycle, a combination of the cycle of the primary closed gas turbine and the cycle of the air turbine circulator. One advantage of this system is that the energy for circulation of the cooling air (which may exceed 25 MW for powerful closed-cycle gas turbines) is produced by the very heat discharged into the atmosphere by the cooling unit. Since the heat exchanger is washed with air at elevated pressure, the dimensions of the cooler can be reduced in comparison to a standard cooling tower. Graphs of the operating characteristics are presented for a closed-cycle helium gas turbine unit of about 180 MW power rating with a cross flow heat exchanger at the end with air flow through the exchanger of 210 kg/s. Five such heat exchangers are used in all. Planning of the device can be based on minimization of its total volume while optimizing the parameters of the turbine circulator. Figure 1, References 2 Russian.
[106-6508]

UDC 538.4

ON THE THEORY OF AN INDUCTION MHD PROPULSION UNIT WITH FREE FIELD

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian
No 3(121), May-Jun 80 pp 105-116 manuscript received 28 Jun 79

YAKOVLEV, V. I., Novosibirsk

[Abstract] An investigation is made of the energy characteristics of an induction MHD system with free field. The analysis is based on examination of a solid body of finite dimensions located in an unbounded conductive fluid with

conductivity σ and density ρ set in motion by electromagnetic forces. The source of the fields is within the solid. The solid is taken as a flat plate of finite width 2a along the x-axis, and infinite extent along the z-axis, moving in its own plane in the direction of the negative x-axis. A method is proposed for improving the efficiency of the proposed MHD induction propulsion unit by "amplitude modulation" in which the energy characteristics of the drive (of finite dimensions) can be brought close to the ideal values. Figures 6, references 9: 8 Russian, 1 Western.
[108-6610]

NAVIGATION AND GUIDANCE SYSTEMS

UDC 531.383

STABILITY OF ROTATION OF A HEAVY GYROSTAT ON A HORIZONTAL PLANE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 4, Jul-Aug 80 pp 11-21 manuscript received 3 Jan 80

RUMYANTSEV, V. V., Moscow

[Abstract] An examination is made of the stability of rotation, and in particular the equilibrium of a heavy gyrostat supported by an arbitrary convex surface on a horizontal plane. It is assumed that the housing of the gyrostat is secured to the axis of rotation of an axisymmetric rotor that turns freely and frictionlessly about this axis at a constant angular velocity. At any given instant the bearing surface of the housing is in contact with the horizontal plane at only a single point where the surface has a certain tangential plane. Necessary and sufficient conditions are found for stability of equilibrium and rotation of the gyrostat about the vertical. An examination is also made of the problem of motion of a heavy symmetric gyrostat with variable gyrostatic torque over a smooth horizontal surface. References 8: 7 Russian, 1 Western.
[112-6610]

UDC 531.55:521.1

ON MAGNETIC-GRAVITATIONAL STABILIZATION OF A TRIAXIAL SATELLITE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 4, Jul-Aug 80 pp 40-49 manuscript received 7 May 79

OGARKOVA, T. N. and KHENTOV, A. A., Gor'kiy

[Abstract] The authors discuss the idea of resonant stabilization of a satellite relative to the magnetic field of the earth when the principal central moments of inertia are unequal, and the central ellipsoid of inertia is close to spherical. It is shown that passive magnetic-gravitational stabilization of a polar satellite with nearly equal moments of inertia is not realistic. Modes of stabilization are also unrealizable on orbits very close to polar. Numerical analysis of the conditions of stabilization establishes ranges of inclination of the orbit of a satellite where solution of the problem is stable. Modes of stabilization may become unstable both due to the action of perturbations, and as a result of

the loss of resonant properties because of a reduction in the dimensions of resonant regions. Figures 9, references 6 Russian.
[112-6610]

UDC 531.39

OPTIMIZING THE PARAMETERS OF STAGED ROCKETS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 5, Sep-Oct 80 pp 36-41 manuscript received 30 Oct 78

KOSMODEM'YANSKIY, V. A., Moscow

[Abstract] Optimization of the flight performance of a nonhomogeneous staged rocket is considered, assuming that the engines in successive stages operate continuously each producing a constant thrust and that the relative velocities of exhaust particles remain constant. The motion of each stage in a uniform gravitational field, disregarding aerodynamic forces, is simulated with a rectilinear motion at an angle to the horizontal plane of the directrix and the separation of a stage is simulated with a vertical motion. After a convenient transformation of the space variable in the equations of motion for all stages, these yield a functional which can be extremized with respect to fuel rate and time of stage detachment. Several design formulas are derived therefrom according to which the rocket performance can be optimized. This procedure is demonstrated on typical maneuvering the space flight of a hypothetical 2-stage rocket, a single-stage V2 rocket, and a multistage Saturn-5 rocket. Figures 2; tables 1; references 6 Russian.
[116-2415]

UDC 629.735.517.27

OPTIMIZATION OF THE TIME REQUIRED FOR AN AIRCRAFT TO CLIMB TO A PREDETERMINED HEIGHT AND REACH A PREDETERMINED FLIGHT SPEED

Yerevan IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: AVIATSIONNAYA TEKHNIKA in Russian No 2, 1980 pp 50-56 manuscript received 23 May 79

IVANOV, V. V. and SIRAZETDINOV, T. K.

[Abstract] A study is made of the problem of determining the proper climbing trajectory of an aircraft to allow it to reach a given height and speed as rapidly as possible. The algorithm suggested for constructing the optimal trajectory is based on analysis of the system of equations describing the motion of the aircraft in a vertical plane. The computational procedure consists of constructing a control function over a given time interval, testing the

limitations and formation of the criteria of optimality in each iteration. Two conditions are used to stop the search: difference between two successive iterations smaller than a predetermined limit, and a time limitation. Figure 1, Tables 3, References 6: 5 Russian, 1 Western.
[123-6508]

UDC 629.12.053"313"

IMPROVEMENT OF SHIP NAVIGATION INSTRUMENTS AND SYSTEMS

Leningrad SUDOSTROYENIYE in Russian No 10, Oct 80 pp 31-34

IVANCHENKOV, V. P. and RIVKIN, B. S.

[Abstract] World sea traffic is expected to increase tremendously during the next decade, along with increases in the tonnage. This calls for adequate navigation instruments and systems to ensure safety and reliability. The basic instruments for measuring the ship course and velocity are gyro or magnetic compasses and hydroacoustic logs respectively, incorporated in radio navigation systems such as LORAN, DECCA, OMEGA and satellite navigation systems such as TRANSIT. While the accuracy of radio navigation systems must still and will be further improved, existing satellite navigation systems do not provide means of locating a ship continuously rather than in 30-90 min intervals only and do not provide enough precision for safe passage through constrictions. The new NAVSTAR system of 24 satellites orbiting at an altitude of 1100 miles should eliminate these deficiencies. Meteorological data will, moreover, be processed by SISAT equipment and a ship's course be charted with MARSAT equipment. Safety problems arise primarily during changes of speed and during encounters threatening collision. Navigation equipment of the future will, by the year 2000, include a central computer with a control panel and an alphanumeric recording device capable of continuous operation and of ensuring safety. It will also include a 2-mode doppler-type hydroacoustic logging system for velocity measurements at depths down to 6000 m, a 2-band radar system, a phototelegraphic receiver on shipboard, time-standard clocks, and an adaptive piloting system, all designed for global coverage. References 14: 6 Russian, 8 Western.
[113A-2415]

UDC 535.345.67

A REFLECTING INFRARED FILTER FOR THE 14.5-25.0 MICROMETER REGION OF THE SPECTRUM

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 6, 1980 pp 33-34
manuscript received 21 Apr 79

MAKAROV, N. F. and STOLOV, Ye. G.

[Abstract] An indium antimonide plate, which completely absorbs radiation at wavelength of 7 μm, was used as one of the filter components to suppress the nonworking spectra of reflecting infrared interference filters in spectrophotometers having diffraction gratings. The transmission factor of the filter in the working region of the spectrum was increased by application of a polymethyl methacrylate film 10-20 μm thick with a brush to the surface of the interference filter before it was glued in place. The possible cracking of the indium antimonide plate during grinding and polishing is considerably less when it is glued to parts made of cadmium telluride polycrystals or single crystals. The filter operated satisfactorily in tests of the IKS-31 spectrophotometer. Figures 1; references 4 Russian, 1 Western.
[111-6521]

UDC 681.7.062:778.38

HOLOGRAPHICALLY FORMED REFLECTING OPTICAL SURFACES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 6, 1980 pp 52-53
manuscript received 13 Jun 79

SATTAROV, F. A.

[Abstract] The image aberrations reconstructed by hologram were evaluated for the case of the substrate surface deviating from the ideal. It was assumed that the refractive indices of the photographic emulsion and of the substrate material were equal and that the thickness of the photographic emulsion was identical over the entire surface of the substrate. Comparison of the reflected and reconstructed waves of the interferogram showed that the reconstructed wave front has significantly fewer aberrations and is in good agreement with the experimental data. Figures 2; references: 2 Russian, 1 Western.
[111-6521]

UDC 535.318

OPTICAL LAYOUT OF TELESCOPE WITH SPHERICAL MAIN MIRROR

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, 1980 pp 11-14
manuscript received 3 Mar 79

PIMENOV, Yu. D.

[Abstract] A general layout is suggested for a three-mirror telescope having spherical shape of the main mirror surface. The formulas used to calculate third-order aberration coefficients and paraxial values were borrowed from previous papers. Different versions of the optical layout are presented with respect to focal length and image curvature. The given optical layout is not intended for any specific telescope and simpler solutions of the design and layout of the interchangeable mirrors are possible when calculating real systems. The difficulties in development of large telescopes are reduced by the great flexibility of the three-mirror system, the high image quality and the possibility of synthesizing the main mirror surface from relatively small spherical mirrors. Figures 3; references 9: 7 Russian, 2 Western.
[113-6521]

UDC 535.312

SYNTHESIS OF SYSTEMS FROM FLAT MIRRORS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, 1980 pp 15-17
manuscript received 16 Aug 78

SIVTSOV, G. P.

[Abstract] Design problems such as variation of direction and position of the optical axis, image rotation and variation of image location are solved by using reflecting systems. A method is proposed for solving the given problems through transformation of selected vectors by a reflecting trihedral system in a specific manner. The solution of the problem is to determine the orthogonal projections of the normals of the mirrors and then determining the position of each mirror in space on the basis of the given location of the image points. The minimum number of mirrors required to solve the problem is established for the case of the parallel path of beams using two and three mirrors. Figures 1; references 4 Russian.
[113-6521]

UDC 535.317.7

OPTICAL COMPENSATION FOR ERRORS IN MANUFACTURE OF ASTRONOMICAL MIRRORS BY ADJUSTMENT OF THE TELESCOPE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, 1980 pp 17-19
manuscript received 23 Mar 79

AGUROK, I. P., ZVEREV, V. A., RODIONOV, S. A., SOKOL'SKIY, M..N. and USOSKIN, V. V.

[Abstract] Methods for calculating the optimum position of parts are developed to accelerate the process of telescope adjustment to enhance image quality. The degree of mean square wave aberration can be determined by the quality of grinding the mirror surface and by the permissible residual aberrations of the telescope. A set of equations is derived for calculating the telescope adjustment and disposition of the various parts of the telescope. The solutions permit one to evaluate image quality and to make the correct decision on the suitability of the mirror surface or on the need to grind it further. References 12: 8 Russian, 4 Western.

[113-6521]

U C 621.284.326.22

CALCULATING THE MAIN PARAMETERS OF SCANNING MIRROR SYSTEMS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, 1980 pp 21-23
manuscript received 21 Apr 79

MITIN, V. P.

[Abstract] The teneral approach is applied to analyzing various types of optical-mechanical scanning systems. An optical-mechanical scanning system not having a scanner is considered in which scanning is accomplished by moving the objective and the detector surface independently of each other. The objective and radiation detector can be immobilized by introducing a plane mirrir into the system. A system of equations is derived for distinguishing two types of scanning systems, in one of which the mirror is located in the front segment of the objective and in the other of which the mirror is located in the rear segment. Figures 3; references 9 Russian.

[113-6521]

UDC 681.787.7:778.38

HOLOGRAPHIC INTERFEROMETER FOR AERODYNAMIC INVESTIGATIONS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, 1980 pp 24-26
manuscript received 15 May 79

BEKETOVA, A. K., LAKHTIONOV, V. I. and LEGU, L. Ye.

[Abstract] Design simplicity, vibrational stability and small overall dimensions of the optical device were taken as the basis to develop a holographic interferometer for aerodynamic installations. The simplest and most compact version of the system was construction of the object side on the basis of two centered concave mirrors which form counter collimators. Screening of the beam is created by the optical components located on the optical axis of the system and other components located in the immediate vicinity of the optical axis, together with their supports and brackets. The angle of holography is varied discretely by rotation and forward motion of a mirror. Given angles can be set with simultaneous compensation for the accompanying shift of the reference beam in the plane of the hologram. The collimator and detector part of the holographic interferometer were installed on separate parts without shock absorbers. The holograms were recorded by the double exposure method, differential interferometry and separate holograms. The system proved to be reliable in operation and promising for aerodynamic investigations. Figures 3; references 2 Russian, 1 Western.
[113-6521]

FLUID MECHANICS

UDC 532.58

INTERNAL WAVES GENERATED BY VERTICAL MOTION OF BODIES THROUGH A NONHOMOGENEOUS FLUID

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 39, No 4, Oct 80 pp 619-623 manuscript received 10 Aug 79

GORODTSOV, V. A., Institute of Problems in Mechanics, USSR Academy of Sciences, Moscow

[Abstract] Vertical motion of bodies through a fluid at subsonic velocities is considered, assuming the fluid pressure and density to be functions of the vertical coordinate only. The energy loss on generation of waves is equations of perturbation for an adiabatic nondissipative process. An axisymmetric solid such as a sphere is considered, also a dipole consisting of a point source and a point sink. With the damping effect on uniform motion taken into account but regarded as sufficiently small, the energy loss is calculated for large values of the Froude number first in the three-dimensional and then in the two-dimensional flow configuration. References 7: 6 Russian, 1 Western.
[119-2415]

UDC 534.013:539.1

SCATTERING OF A TRANSIENT TORSIONAL WAVE BY A STATIONARY RIGID SPHERE IN AN ELASTIC MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 5, Sep-Oct 80 pp 86-92 manuscript received 24 Sep 79

GRILITSKIY, D. V. and PODDUBNYAK, A. P., L'vov

[Abstract] Axisymmetric scattering of a transient plane torsional (SH) wave by a stationary rigid sphere in an infinitely large elastic medium is considered, such a wave being generated by twister operating in the pulse mode. Displacements in the scattered wave are calculated by solving the wave equation for the condition of contact between rigid sphere and elastic medium, with application of the causality principle. The exact solution has the form of a convolution integral, the kernel of which is expanded asymptotically in a rapidly converging series after a Watson transformation. The scattered torsional wave is found to

constitute a cluster of individual waves, some resulting from straight reflection and others resulting from diffraction by the rigid surface. Accordingly, the echo signal can be approximated as consisting of a primary pulse in the bright field and a sequence of secondary pulses in the dark field. Typical calculations are shown for a torsional wave with a form of the Dirac delta function. Figures 3; references 20: 13 Russian, 7 Western.
[116-2415]

UDC 533.6.013.42

OPTIMIZATION OF A PLATE FOR STABILITY IN A SUPERSONIC GAS STREAM

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 5, pp 141-147 manuscript received 15 Jun 79

SEYRANYAN, A. P., Moscow

[Abstract] A thin elastic plate of variable thickness is considered in a supersonic gas stream. The plate is symmetric with respect to its neutral plane and first assumed to be infinitely long in the direction across the stream, rigidly clamped along one edge and free at the other edge. The aerodynamic forces on the plate are described by the linearized law of plane sections. After the equation of transverse vibrations has been formulated in terms of a complex function of a real variable and reduced to dimensionless form, the stability criteria are established in terms of divergence rate and flutter rate. The optimization problem for such a plate is then formulated on a unit-length basis as follows: to determine the thickness profile which, with the volume remaining invariable, will maximize the smaller of the two critical rates. Accordingly, the plate is optimized with respect to the critical divergence rate and then tested for stability with respect to the critical flutter rate. The stability limit of the unperturbed equilibrium mode is examined, furthermore, and its dependence on the stream velocity is determined through solving the fundamental equation of damped transverse vibrations by the Bubnov-Galerkin method and applying the Routh-Hurwitz criterion. Both a forward stream and a backward stream are considered. In the latter case it has been found that a stability analysis of the optimum plate by the method of finite differences is more reliable. The author thanks F. L. CHERNOUSKO for the interest in this study and N. M. GURA for the assistance in numerical calculations. Figures 5; references 11: 8 Russian, 1 Western.
[116-2415]

UDC 533.6.013.42

PARAMETRIC VIBRATIONS OF ELASTIC PANELS IN A SUPERSONIC GAS STREAM

Moscow IZVESTIYA AKADEMII NAUK SSR: MEKHANIKA TVERDOGO TELA in Russian No 5, Sep-Oct 80 pp 148-152 manuscript received 7 May 79

BABIN, O. A., VOROB'YEV, V. I. and SEMENOV, V. A., Moscow

[Abstract] An elastic flat and narrow panel is considered with a constant force and an alternating force acting additively on its median surface from both long edges and with a supersonic gas stream flowing on one side. The vibrations of this panel are calculated from the equation of small deflections w(x,t) in the cylindrical flexure mode, with the deflection rate $\frac{\partial w}{\partial t} + U\frac{\partial w}{\partial x}$ assumed to be approximately proportional to the aerodynamic excess pressure $p-p_{\infty}$ (where U and p_{∞} denote the quiescent velocity and pressure) in a polytropic process. With the parameters referred to their characteristic values and the deflection expressed in the form of a series, the fourth-order differential equation of vibrations reduces to a dimensionless second-order differential matrix equation. The latter is further reduced to the normal Cauchy form by means of phase variables and the stability of its zero-point solution analyzed by the method of numerical integration over one period. The stability region in the frequency-excitation plane is found to narrow down and shift toward lower frequencies as the stream velocity parameter increases from below to above its critical value. Adequate damping tends to eliminate instability wedges at supercritical stream velocities. Figures 4; references 6: 5 Russian, 1 Western.
[116-2415]

UDC 533.6.013.42

DIFFRACTION OF A PLANE STEPPED PRESSURE WAVE BY AN ELLIPTICAL CYLINDER AND BY A STRIP

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 5, Sep-Oct 80 pp 153-157 manuscript received 12 Nov 79

KARPENKO, V. V., Leningrad

[Abstract] Diffraction of a plane stepped pressure wave by a rigid elliptical cylinder is considered, the wave front remaining parallel to the cylinder generatrix while the angle of incidence is arbitrary. The condition of impermeability is stipulated at the cylinder surface and zero-value conditions are assumed at an infinite distance from it. The solution to the diffraction problem is written in the form of a double integral involving periodic and modified Mathieu functions, based on the Green function for the second boundary-value problem in the general case of any acoustic wave. The inner integral is evaluated upon replacement of the periodic Mathieu functions with trigonometric Fourier series. The calculations

simplify for an elliptical cylinder degenerating into a narrow strip with the semiminor axis approaching zero. Numerical results are shown for 90° and 45° angles of incidence. Figures 1; tables 1; references 7 Russian.
[116-2415]

UDC 533.6.011.5

ON THE THEORY OF A LOW-ASPECT WING IN A HYPERSONIC FLOW

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 4, Jul-Aug 80 pp 112-117 manuscript received 27 Mar 79

GOLUBKIN, V. N., Moscow

[Abstract] The author considers hypersonic flow of a gas around the windward surface of a low-aspect wing at an angle of attack. The method of small perturbations is used to find an explicit relation for the way that the compression shock depends on the configuration of the wing surface and the planform of the leading edge. It is shown that the pressure on a flat wing is completely determined by the shape of the compression shock. Figures 3, references 11: 9 Russian, 2 Western.
[110-6610]

UDC 532.5.013.4:536.25

SUPERCRITICAL CONVECTIVE MOVEMENTS IN A SHORT HORIZONTAL CYLINDER

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 4, Jul-Aug 80 pp 137-142 manuscript received 2 Mar 79

BOGATYREV, G. P. and GILEV, V. G., Perm'

[Abstract] As a result of crisis of mechanical equilibrium of a liquid heated from below in a closed cavity, monotonic convective movement arises with a spectrum that depends on the shape of the cavity. As the Rayleigh number increases, steady-state motion becomes unstable, and periodic convective oscillations arise, becoming irregular as supercriticality increases. In this paper, the authors study the development of supercritical movements and the nature of irregular convective oscillations of a liquid in a horizontal cylinder with diameter of 30.9 ± 0.1 mm, and length of 4.7 ± 0.01 mm. The cylinder was bounded on the ends by two vertical brass plates measuring 110 x 90 x 9 mm, between which was a Plexiglas insert with a circular recess determining the size and shape of the cavity. The temperature difference between the top and bottom of the cavity was strictly maintained by a heater and cooler, and the temperature gradient was measured by a thermocouple. Convective motion arose at a Rayleigh number of $R = 13.1 \pm 0.2$ defined in terms of the half-width of the cavity and the

temperature gradient. The first critical movement is bicellular with the liquid rising or falling in the center of the cavity and moving in the opposite direction at the walls. Three-cell and four-cell movements arise at Rayleigh numbers of 23.0 and 35.0 respectively. The direction of motion in each of the cells is randomly determined. The reverse transitions with decreasing Rayleigh number occur at R = 26.7 and 20.1. If the model is turned at an angle about the horizontal axis of the cylinder, a transition to unicellular motion can be seen. The reverse transition takes place as the angle decreases. An increase in supercriticality gives rise to vortex movements within the cells, and monotonic four-cell motion breaks down at $R_* = 70 \pm 2$. Breakdown is preceded by rocking of the four-cell pattern about the horizontal axis of the cylinder. Beyond this point, the visually observed flow pattern is unstable with continuous shifting of small eddies and change in their size. Small thermics arise and disappear close to the vertical diameter. Under certain conditions a four-cell structure may be temporarily re-established. It is shown that in certain cases the small-scale motion may be modulated by the large-scale mode with intensity that varies randomly in time. Figures 5, references 9: 6 Russian, 3 Western.
[110-6610]

UDC 553.6.0.155

HEAT EXCHANGE ON THE SHED LINE OF A SWEPTBACK CYLINDER IN A NONUNIFORM HYPERSONIC FLOW

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 4, Jul-Aug 80 pp 157-179 manuscript received 8 Feb 79

ZEMLYANSKIY, B. A. and SHMANENKOVA, G. A., Moscow

[Abstract] A method is proposed for calculating heat exhhange on the shed line of blunt edges with moderate sweepback, considering the influence of absorption of an inviscid swirling flow by the boundary layer. The method is based on combining calculation of heat exchange in a single algorithm with a simplified technique for approximate calculation of parameters of inviscid flow across a compressed layer by constructing stream lines in the shed plane with known newtonian pressure distribution. This reduces the three-dimensional problem of heat exchange on the shed line to an equivalent axisymmetric problem for an effective body. The results correlate well with experimental data. Figures 2, references 6: 5 Russian, 1 Western.
[110-6610]

UDC 532.011.1

STATEMENT OF THE PROBLEM OF THE MOVEMENT OF A BODY IN WATER

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep-Oct 80 pp 19-26 manuscript received 2 Apr 79

YAKIMOV, Yu. L., Moscow

[Abstract] A study is made of steady-state potential flow of an ideal incompressible liquid around bodies, assuming non-negative pressure on the boundary. This limitation leads to certain physical properties, which affect the analysis of the situation at the limit corresponding to low initial pressure or rapid movement of the body. Where the Euler number is equal to 0, the resistance of the body is always finite, the minimum resistance occurring for bodies with geometry the same as the shape of the cavity containing the body and fluid. Finite resistance is proven in the general case. Equations are derived which contain previously known limiting asymptotic equations and also allow determination of the variation in cavity shape as a function of various conditions. References 10 Russian.
[117-6508]

UDC 532.59.013

DIFFRACTION OF PLANAR WAVES ON AN INFINITELY LONG ELASTIC ROD FLOATING ON THE SURFACE OF A LIQUID

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep-Oct 80 pp 62-67 manuscript received 15 May 79

KUDRYAVTSEV, Ye. P., Moscow

[Abstract] A study is made of the way that plane waves coming from infinity interact with an infinitely long elastic rod floating on the surface of an ideal fluid of unlimited depth. The parameters of the waves passing the rod and reflected from it are calculated, assuming that the rod remains always in contact with the surface of the fluid, and the force factors are found in cross sections of the rod. Numerical solutions of the equation system for motions of the rod and waves are found by the method of reduction. Figures 3, References 3 Russian.
[117-6508]

UDC 533.6.011

CALCULATION OF THE THREE-DIMENSIONAL TRANSONIC FLOW OF AN IDEAL GAS THROUGH AXIAL TURBOMACHINE CASCADES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep-Oct 80 pp 93-98 manuscript received 27 Mar 79

BOGOD, A. B., KIMASOV, Yu. I., Moscow

[Abstract] A study is made of the steady flow of gas in an isolated axial turbine wheel rim of a predetermined but arbitrary shape rotating at a known angular velocity. The region of calculation is therefore a channel formed by the inner and outer rims of the wheel, the surfaces of two neighboring vanes, and surfaces which are their continuations, passing through the centers of the leading and trailing edges of the vanes extending to the ends of the region covered by the calculation, a distance on the order of the height of the vanes. The system of equations describing the unsteady three-dimensional motion of the inviscid gas consists of the integral laws of conservation applied to each of the cells into which the region is divided. Boundary conditions are defined and the construction of the three-dimensional calculation grid is described in detail. The capabilities of the computation method are investigated for the example of the drive wheel of a compressor. Figures 5, References 15: 8 Russian, 7 Western.
[117-6508]

UDC 533.6.011.351

TRANSONIC FLOWS AROUND A WING PROFILE IN CHANNELS WITH PERMEABLE BOUNDARIES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian No 5, Sep-Oct 80 pp 99-107 manuscript received 9 Apr 79

BLYNSKAYA, A. A., LIPSHITS, Yu. B., Moscow

[Abstract] A study is made of a wing profile at a small angle of attack in a wind tunnel whose walls are straight and parallel, carrying a flow of gas near the speed of sound. The gas is considered to have no viscosity or heat conductivity. The situation is complicated by the fact that the walls of the tunnel are perforated. Flow parameters are determined by numerical solution of a boundary value problem for the velocity potential equation as applied to flow around a wing in a channel with porous boundaries. The results are then used to construct an asymptotic theory of the influence that the height of the wind tunnel and the Mach number of the oncoming flow have on the characteristics of flow around the profile. References 20: 16 Russian, 4 Western.
[117-6508]

UDC 533.6.011.5

INJECTION OF FLUID INTO A SUPERSONIC FLOW THROUGH A PERMEABLE SURFACE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 5, Sep-Oct 80 pp 108-114 manuscript received 24 Apr 79

VIGDOROVICH, I. I., Moscow

[Abstract] A study is made of the injection of fluid from a reservoir at constant pressure through a flat permeable plate into a supersonic stream of gas. A thin layer of the injected fluid is formed on the flat plate, and the supersonic flow moves around the layer. The fluid is injected over the entire length of the plate, from edge to edge. The flow in the layer of injected fluid is considered inviscid and incompressible, the relative thickness of the layer is considered small. The universal functions derived in this article allow the distribution of pressure over the plate and the shape of the contact surface to be determined. Figures 3, References 16: 14 Russian, 2 Western.
[117-6508]

UDC 538.4:532.526.4

SOME PROBLEMS RELATING TO TURBULENT ELECTROHYDRODYNAMIC JETS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 5, Sep-Oct 80 pp 144-149 manuscript received 13 Jul 79

VATAZHIN, A. B., GRABOVSKIY, V. I., Moscow

[Abstract] A theoretical study is made of a turbulent axisymmetric electrohydrodynamic jet issuing from a circular nozzle into an interelectrode gap. Two grounded electrode grids extending to infinity in the transverse direction are located at the nozzle exit cross section. The neutral jet carries charged particles, either ions or large particles with or without inertia. The concentration of charged particles, electric current, electric potential and electric field intensity are calculated using the known velocity field of the fluid. The velocity of the fluid is calculated using a single-parameter model of turbulence. Figures 4, References 13 Russian.
[117-6508]

UDC 532.526.013.4

INTERACTION OF WAVE DISTURBANCES IN AN OSCILLATING BOUNDARY LAYER

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 5, Sep-Oct 80 pp 154-158 manuscript received 16 Apr 79

LEVCHENKO, V. Ya., SOLOV'YEV, A. S., Novosibirsk

[Abstract] A theoretical study is presented of the interaction of wave disturbances of small but finite amplitude in a boundary layer for the case where the distribution of velocity includes a periodic component oscillating harmonically. The possibility is demonstrated of four-wave synchronous interaction at cubic nonlinearities and equations are obtained for the amplitudes. The calculations show that the oscillations do not affect the process of interaction of Tolmin-Schlichting waves. The results thus indicate that harmonic oscillations of a flow increase the initial amplitude of the waves near the forward edge of the plate, after which the waves develop independently of the imposed oscillations. Figures 2, References 12: 8 Russian, 4 Western.
[117-6508]

UDC 533.6.011.5

DETERMINATION OF VORTEXING ON A LOW ASPECT WING IN A HYPERSONIC FLOW

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 5, Sep-Oct 80 pp 157-178 manuscript received 28 May 79

GOLUBKIN, V. N., Moscow

[Abstract] The theory of a thin shock layer is used to obtain an equation for computation of vortexing on a low aspect wing in a hypersonic gas flow. It is shown that for certain wing shapes and flow modes, zones will appear with high local values of vortexing. An analytic expression for the flow component of vortexing at the leading edgu of the wing as a function of wing configuration is produced for the first time. Examples of the formation of narrow zones of highly vortexed flow are presented. Figures 2, References 6: 4 Russian, 2 Western.
[117-6508]

UDC 533.6.011.534.35

EXPERIMENTAL STUDY OF FLOW IN THE NOZZLES OF GAS-DYNAMIC LASERS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 5, Sep-Oct 80 pp 178-182 manuscript received 15 May 79

KTALKHERMAN, M. G., MAL'KOV, V. M., RUBAN, N. A., Novosibirsk

[Abstract] A study is made of the structure of the flow in a number of flat, small nozzles. The aerodynamic measurements were performed on an installation consisting of a forechamber with a flow-smoothing grid, models of nozzles leading into a channel of constant cross section, a transition area and an ejector. The distribution of pressure on the walls of a laser channel with the same nozzles at the intake was also determined, allowing the results of measurement in cold and hot flows to be compared. Figures 5, References 9: 8 Russian, 1 Western.
[117-6508]

UDC 533.6.011.72

GEOMETRIC STUDY OF SPECIFICS OF THE PROCESS OF REGULAR REFLECTION OF SHOCK WAVES FROM A WALL

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian
No 5, Sep-Oct 80 pp 182-185 manuscript received 21 Jun 79

LE KUOK KHYU, Moscow

[Abstract] A geometric approach was used to find a new relationship between the geometric characteristics of a slanting shock wave. The equations produced are used to prove certain specifics of the process of reflection of such a wave. References 3 Russian.
[117-6508]

UDC 532.527

A NUMERICAL STUDY OF THE STRUCTURE OF FLOW SURFACES NEAR HIGHLY LOADED WINGS

Yerevan IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: AVIATSIONNAYA TEKHNIKA in Russian
No 2, 1980 pp 35-39 manuscript received 3 May 79

GRUZDEV, A. A.

[Abstract] A study is made of the deformation of a contour which is rectangular in an unperturbed flow but changes its shape and size under the influence of a source of perturbations, a π-shaped circulation vortex moving in a stream of

nonviscious fluid. An equation is presented which describes the motion of the free vortices. Figures 3, References 5: 3 Russian, 2 Western.
[123-6508]

UDC 533.6.0115:536.63

CALCULATION OF FLOW AROUND A PROFILE WITH VARIABLE HEAT CAPACITY

Yerevan IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: AVIATSIONNAYA TEKHNIKA in Russian No 2, 1980 pp 77-82 manuscript received 23 Jan 79

SIDOROV, O. P.

[Abstract] The hydrodynamic elements in the air flow around a profile with a compression jump are calculated by combining the compressive and expansion flows. Bernoulli's equation is used to produce an ordinary differential equation for the function ϕ. All known equations used for calculation of the compression and expansion cross sections must be altered for this case. The final result is a decrease in the lift of the profile and in the extent to which it is heated by the airflow. Figures 2, References 3 Russian.
[123-6508]

UDC 621.165-226.3:001.89:533.6

SELECTION OF THE HEIGHT OF A SUPPLEMENTARY VANE IN A TURBINE CASCADE

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian No 8, 1980 pp 66-69 manuscript received 13 Dec 78

BASHUROV, B. P., candidate of technical sciences, senior instructor

[Abstract] An experimental study is performed in order to determine the area of rational utilization of supplementary turbine vanes. The influence that nonuniformity of the flow at the entry to a cascade has on the loss of energy upon installation of supplementary vanes on the outer surfaces was studied with a broad range of change of spacing between vanes. The flat turbine cascade consisted of six vanes. Two versions of relative supplementary vane height were studied with two versions of flow vortexing. It is found that the installation of supplementary vanes decreases the negative influence of secondary vortex flows and thus decreases the energy loss in the cascade. As the height of the supplementary vane is approximately doubled, the optimal relative spacing also approximately doubles and the positive effect is increased by approximately 50%. Figures 2, References 7 Russian.
[105A-6508]

UDC 532.526.4

DETERMINATION OF THE FRICTION DRAG IN CHANNELS WITH TURBULENT FLOW

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian
No 8, 1980 pp 69-74 manuscript received 22 Jan 79

YEROSHENKO, V. M., doctor of technical sciences, ZAYCHIK, L. I., candidate of technical sciences and YANOVSKIY, L. S., graduate student

[Abstract] A method is presented for calculating the friction drag in channels with forced injection and evacuation, based on a two-layered plan using the Prandtl model. All of the hypotheses analyzed lead to different variations of the characteristics of the flow near the wall. Only one hypothesis agrees with the experimental data for all values of injection and evacuation at the wall. Figures 3, References 16: 12 Russian, 4 Western.
[105A-6508]

UDC 532.595

MOVEMENT OF A FLUID THROUGH CHOKING ELEMENTS SUBJECT TO VIBRATION

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian
No 8, 1980 pp 74-78 manuscript received 23 Jan 79

PENZIN, V. V., graduate student

[Abstract] A study was made of the influence of longitudinal vibration on the kinematic characteristics of choking elements (nozzles) through which a fluid (water) flowed over the range of Reynolds numbers 350 to 100,000 through both capillary and external cylindrical nozzles with relative lengths of 1-10 diameters. A diagram of the experimental installation used is presented. Well-known dimensionless quantities were used to process the experimental data thus produced, determining the flow rate, theoretical Reynolds number, vibration acceleration factor, relative length and diameter of the choking element. The results of the experiment showed that longitudinal vibration decreases the discharge through a choking element through an aperture of the same diameter, after which the vibration causes the flow to be interrupted. In capillary nozzles the vibration cutoff of flow is observed at flow rates lower than the flow rate of the corresponding aperture. The influence of vibration increases with increasing vibration acceleration. Equations and a figure are presented which can be used for the design of hydraulic nozzles which must operate under conditions of vibration, discharging fluids into the atmosphere. Figures 2, References 3 Russian.
[105A-6508]

UDC 532.526

SOME SPECIFICS OF THE SOLUTIONS OF BOUNDARY-LAYER EQUATIONS ON A MOVING SURFACE

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 44, No 5, Sep-Oct 80
pp 831-838 manuscript received 5 Nov 79

SYCHEV, V. V., Moscow

[Abstract] A study is made of the behavior of the solution of laminar boundary-layer equations for the two-dimensional steady flow of an incompressible fluid with a fixed positive pressure gradient, acting on a finite section of a surface, which moves downstream at a constant speed. The behavior of the solution to the boundary-layer equations is studied in the vicinity of a point with coordinates $(0, Y_0)$, where Y_0 is a certain constant. The pecularities which arise on the axis of symmetry of a laminar wake in an incompressible fluid with a fixed positive pressure gradient are studied. Figures 3, References 11: 4 Russian, 7 Western.
[120-6508]

UDC 533.6.011.8

ASYMPTOTIC THEORY OF A LAYER OF NONEQUILIBRIUM IONIZATION NEAR A CATALYTIC WALL IN A PLASMA OF MOLECULAR GASES

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 44, No 5, Sep-Oct 80
pp 839-846 manuscript received 16 Jan 80

BENILOV, M. S. and TIRSKIY, G. A., Moscow

[Abstract] A study is made of a moderately ionized multicomponent gas consisting of N neutral components, positive singly charged atoms of one of the neutral components and electrons. It is assumed that the gas as a whole is at rest and its pressure is constant. All of the binary diffusion coefficients depend on temperature in the same manner. The temperature of the gas is determined by a fixed monotonically increasing function of the y coordinate (perpendicular to the wall). The distribution of the quasi-neutral concentration of charged particles is studied under these conditions both with and without electric current. It is concluded that the physical picture of deviation from ionization equilibrium near an ideal catalytic wall established in an earlier work for ionization by electron impact and recombination with only electrons acting as the third body remains essentially the same for the case of chemical kinetics studied in this article, in which ionization of the atoms of the most easily ionized component may occur upon collision both with electrons and with molecules of one of the neutral components, and the third body in ion-electron recombination may be electrons or molecules of the first component. References 4 Russian.
[120-6508]

UDC 533.6.011

AN EXAMPLE OF TRANSONIC FLOW AROUND A BODY WITH A DISCONTINUITY IN THE CURVATURE OF THE CONTOUR

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 44, No 5, Sep-Oct 80 pp 950-952 manuscript received 26 Nov 79

IVANOV, V. A. and CHERNOV, I. A., Saratov

[Abstract] A study is made of the exact solution of transonic equations, a generalization of a known self-similar solution describing transonic flow around the corner point of a body. The isoline $u=\text{const}>0$ rather rapidly becomes straight, which wilustrates one of the properties of the solution, which is asymptotically transformed to a Brandtl-Meyer rarefaction wave. Figures 2, References 5: 3 Russian, 2 Western.
[120-6508]

UDC 621.438

AERODYNAMIC DAMPING OF VIBRATIONS OF TURBINE BLADES UNDER CONDITIONS OF SEPARATION FLOW IN A NONUNIFORM STREAM

Kiev PROBLEMY PROCHNOSTI in Russian No 10, Oct 80 pp 28-30 manuscript received 12 Apr 80

KAMINER, A. A., DUNAYEV, A. V. and STEL'MAKH, A. L., Institute of Problems in Strength, UkSSR Academy of Sciences, Kiev

[Abstract] Aerodynamic damping of torsional vibrations of turbocompressor blades was studied at the Institute under conditions of full-separation flow in a nonuniform gas stream, torsional vibrations being most likely associated with stall flutter. The logarithmic amplitude decrement of blade vibrations in cascades with various pitches and stagger angles was measured as a function of the vibration coherence in the stream, at various angles of attack and various values of the Struhal number. The results indicate trends peculiar to full-separation flow and qualitatively different than those characterizing nonseparation or partial-separation flow. Thus changing the pitch of the blade row can either increase or decrease the aerodynamic damping, depending on the Struhal number and on the phase shift of vibrations. Changing the stagger angle of the blade row does not significantly affect the aerodynamic damping under any flow conditions. Aerodynamic damping was further studied in a nonuniform stream with vortex trails, which characterize the operation of turbomachinery, and was found not to be significantly affected by the latter. Figures 5; references 2 Russian.
[121-2415]

UDC 532.32

BIFURCATION OF FLUID FLOWS BETWEEN TWO PERMEABLE ROTATING CYLINDERS

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 99, No 2, Aug 80 pp 325-328 manuscript received 24 Apr 80

SHAPAKIDZE, L. D., Tbilisi Mathematics Institute imeni A. M. Rasmadze, Georgian SSR Academy of Sciences

[Abstract] The author considers the problem of flow of an incompressible viscous fluid filling the annulus between two permeable cylinders with radii R_1, R_2, ($R_2 > R_1$) rotating at angular velocities Ω_1, Ω_2. Expressions are found for the steady periodic rotationally symmetric flows with given period $2\pi/\alpha_0$ along the axis of the cylinders, assuming that the fluid discharge is zero through the cross section of the annulus. It is proved that when the condition $\mu < \eta^2$ is met, where $\mu = \Omega_2/\Omega_1 > 0$, $\eta = R_1/R_2$, the problem has points of bifurcation for any α_0 with the exception of some countable set. If this condition is not satisfied by the ratios of radii and velocities, there is no bifurcation, and flow is stable, as shown by exact solution of the initial Navier-Stokes equation. References 4 Russian.
[105-6610]

UDC 532.516

UNSTEADY ROTATION OF A CYLINDER IN A VISCOUS LIQUID

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian No 3(121), May-Jun 80 pp 66-69 manuscript received 12 Jun 79

SENNITSKIY, V. L., Novosibirsk

[Abstract] An examination is made of the problem of rotation of a circular cylinder in a viscous incompressible fluid when a constant external torque acts per unit of length of the cylinder starting at time zero. It is assumed that flow of the liquid is two-dimensional and that the cylinder and fluid are at rest before time zero. Curves are plotted for $\omega = 4\pi \rho \alpha^2 \Omega / M$ as a function of $\tau = \nu t/\alpha^2$ at various $\kappa = 2\pi\rho\alpha^4/I$, where ρ is the density of the liquid, α is the radius of the cylinder, Ω is the angular velocity of rotation of the cylinder, M is the external torque, ν is the kinematic coefficient of viscosity, t is the elapsed time and I is the moment of inertia of a unit of length of the cylinder. The author thanks L. Ya. Rybak for doing numerical calculations of the angular velocity of rotation of the cylinder. Figures 2, references 4: 2 Russian, 2 Western.
[108-6610]

MECHANICS OF SOLIDS

UDC 539.3

CRITICAL LOADS FOR DEVELOPABLE SHELLS UNDER A PRESSURE LINEARLY VARYING ALONG THE GENERATRIX

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 9, Sep 80 pp 36-39 manuscript received 6 Nov 79

BABENKO, V. I., Physico-Technical Institute of Low Temperatures, UkSSR Academy of Sciences

[Abstract] Linearly elastic and anisotropic thin developable shells, convex without flattening, of medium length are considered under a static pressure load acting on the convex side and varying linearly along the generatrix of the median surface. For such a shell bounded by two straight bases and two curving bases, with any possible constraints at the straight bases, the critical load and thus the stability limit are calculated by minimizing the eigenvalue of the appropriate boundary-value problem. Results of a numerical solution by the Ritz method and by reduction to the Cauchy problem are given here in tabular and graphical form. The article was presented by academician (UkSSR Academy of Sciences) A. V. POGORELOV. Figures 3; tables 2; references 3 Russian. [118-2415]

UDC 539.3

EFFECT OF A FLUID ON THE PROPAGATION OF LONGITUDINAL WAVES THROUGH A PRESTRESSED CYLINDER MADE OF AN INCOMPRESSIBLE MATERIAL

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 9, Sep 80 pp 39-42 manuscript received 27 Nov 79

BAGNO, A. M. and Academician, UkSSR Academy of Sciences GUZ', A. N., Institute of Mechanics, UkSSR Academy of Sciences

[Abstract] Propagation of axisymmetric waves through an incompressible and transversely isotropic infinitely long hollow circular cylinder containing a compressible fluid is considered in the case of large but finite initial strains. The problem is formulated in two differential equations of dynamic hydroelasticity,

including the wave equation, in accordance with the three-dimensional linearized theory and with four appropriate boundary conditions. The problem is reduced to four homogeneous linear algebraic equations which yield the dispersion equation describing the propagation process in such a system. This dispersion equation has been solved numerically with the aid of an M-4030 computer by the iteration method for typical values of the system parameters. Results pertaining to the first two propagation modes indicate that, while initial stresses in the cylinder increase the phase velocity of waves under both compression and tension, the fluid decreases the phase velocity of waves more under compression than under tension. Figure 1; references 5 Russian.
[118-2415]

UDC 539.3

STATE OF STRESS OF MULTILAYER SHELLS OF REVOLUTION WITH GEOMETRICAL NONLINEARITY AND WITH SHEAR

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 9, Sep 80 pp 46-50 manuscript received 24 Mar 80

GRIGORENKO, Ya. M., corresponding member of the UkSSR Academy of Sciences and TIMONIN, A. M., Institute of Mechanics, UkSSR Academy of Sciences

[Abstract] Geometrically nonlinear axisymmetric deformation of orthotropic multilayer shells is considered, taking also into account transverse shear. The equations of equilibrium, derived from the principle of possible displacements, are nonlinear in projections on the undeformed coordinate surface. Together with the elasticity relations, they yield the forces and the moments as well as deflections. A numerical solution of the quasilinearized problem by the method of discrete orthogonalization has been programmed in ALGOL - GDR and realized on a BESM-6 high-speed computer. Typical results for a triple-layer circular conical shell rigidly constrained around the small base and loaded by an external pressure indicate the convergence of such a solution as well as the effects of shear and geometrical nonlinearity. Figure 1; table 1; references 8 Russian.
[118-2415]

UDC 517.9:539.3

AXISYMMETRIC STATE OF STRESS OF A SPHERE WITH AN ECCENTRIC SPHERICAL CAVITY

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 9, Sep 80 pp 50-55 manuscript received 27 Dec 79

KAPSHIVYY, A. A., KOPYSTYRA, N. P., and LOMONOS, L. N., Kiev State University

[Abstract] Compression of an elastic sphere with an eccentric spherical cavity is considered as a problem in axisymmetric theory of elasticity. For boundary

conditions stipulated in terms of displacements at both surfaces, the problem is solved by the method of p-analytical functions (G. N. Poloshyy) in cylindrical coordinates with the origin at the center of the sphere and reduction to an infinite system of linear algebraic equations. The article was presented by academician (UkSSR Academy of Sciences) I. I. LYASHKO. Figure 1; references 7 Russian.
[118-2415]

UDC 539.384:624.073

SOME PECULIARITIES OF OPTIMAL STABILITY PROBLEMS INVOLVING SHELLS OF VARIABLE THICKNESS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA A: FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 9, Sep 80 pp 59-63 manuscript received 22 Oct 79

MEDVEDEV, N. G., Institute of Mechanics, UkSSR Academy of Sciences

[Abstract] A problem of shell stability is considered where the thickness is to be varied along the height so as to maximize the critical load, under constraints on weight and strength as well as on the thickness. The corresponding infinite-dimensional optimization problem is first approximated with a sequence of finite-dimensional ones, then through the use of penalty functions formulated as a problem in nonlinear programming, and as such reduced to an optimization problem without constraints. This problem is solved by the method of conjugate gradients. The results agree with the engineering method of optimizing a structure and confirm that the critical load as well as the mode of stability loss are determined by the smallest positive eigenvalue. The article was presented by academician (UkSSR Academy of Sciences) A. N. GUZ'. Figures 2; references 7: 6 Russian, 1 Western.
[118-2415]

UDC 534.21

MODULATION EQUATIONS IN NONLINEAR DISPERSING MEDIA AND THEIR APPLICATION TO WAVES IN THIN BODIES

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, MEKHANIKA in Russian No 3, 1980 pp 29-40 manuscript received 10 Apr 79

BAGDOYEV, A. G. and MOVSISYAN, L. A., Institute of Mechanics, Armenian Academy of Sciences

[Abstract] Utilizing an extension of a method published earlier for producing modulation equations using an averaged Lagrangian to consider the second derivatives of amplitude for an arbitrary medium, modulation equations are derived in a

three-dimensional statement. Conditions of stability are written, as well as expanded conditions of stability of the wave. An asymptotic expansion is presented for the linear solution published earlier, and it is demonstrated that the equations of modulation are satisfied. A comparison with a nondispersing medium is presented. The solution of the corresponding nonlinear problem is presented, and the equations and conditions produced are applied to problems of propagation of bending waves in plates and shells. References 8: 7 Russian, 1 Western. [122-6508]

UDC 537.312.5:539.6

THE PROBLEM OF MAGNETOELASTIC OSCILLATIONS OF A PLATE CONSIDERING THE HALL EFFECT

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, MEKHANIKA in Russian No 3, 1980 pp 54-65 manuscript received 3 Dec 79

KAZARYAN, K. B., Institute of Mechanics, Armenian Academy of Sciences

[Abstract] The study is made of the problem of oscillations of an electrically conductive, infinite elastic plate when an external magnetic field is present, considering the Hall effect. Bias currents are ignored as being much less significant than conductivity currents. It is assumed that the permeability of the material of which the plate is made is equal to 1 and that the plate is immersed in a vacuum. The material of the plate has finite conductivity. The influence of Hall effect currents on the frequency of the magnetoelastic oscillations of the plate is found to be negligible for both longitudinal and transverse magnetic fields in the range of values of H_0 of up to 8×10^6 A/m. The influence of Hall currents on the oscillating frequency can be significant in this same range for semiconductor plates, however. Tables 2, References 9: 7 Russian, 2 Western. [122-6508]

UDC 534.26

IMPACT OF ELASTIC SHELLS AGAINST THE SURFACE OF A COMPRESSIBLE FLUID

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, MEKHANIKA in Russian No 3, 1980 pp 66-75 manuscript received 15 Nov 79

SAGOMONYAN, A. Ya. and DVORKIN, Ya. P., Department of Mechanics and Mathematics, Moscow State University imeni M. V. Lomonosov

[Abstract] A numerical method is suggested for studying the problem of impact of shells entering a compressible fluid at high velocity, allowing the extreme values of stress to be determined and considering the rise in the level of the free surface of the fluid as the shell enters it. The entry of closed elastic cylinders and spherical shells filled with an ideal compressible fluid is studied.

New analytic solutions are produced for the initial stage of immersion, when the free surface of the fluid is not disturbed, for the vertical entry of closed cylindrical and spherical shells through the horizontal surface of an ideal compressible fluid at rest. It is assumed that the impact velocity is much less than the speed of sound in the fluid. The results show that the maximum stresses in the shells may develop during the period of penetration, when it is important to consider the compressibility of the fluid. Figures 5, References 10: 6 Russian, 4 Western.
[122-6508]

DYNAMIC TWISTING OF A HOLLOW CYLINDER BY A LOAD DISTRIBUTED ALONG THE LATERAL SURFACES

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: FIZIKA, TEKHNIKA MATEMATIKA in Russian No 6, 1979 pp 29-35 manuscript received 10 May 79

IL'YASOV, M. Kh., Institute of Mathematics and Mechanics, Azerbaijan Academy of Sciences

[Abstract] The problem of dynamic twisting of an infinitely long hollow cylinder, the load on which is applied to the lateral surfaces, is solved for an elastic cylinder at rest at the moment of application of the load. The stress-strain state of the cylinder during subsequent moments in time is determined. The propagation of shear waves is studied for cases of application of loads to several sections of the inner and outer surfaces of the cylinder, particularly for concentrated annular loads. References 2 Russian.
[124-6508]

UDC 539.4

CRITERIA OF PROPAGATION OF LONGITUDINAL AND TRANSVERSE CRACKS IN CLOSED CYLINDRICAL SHELLS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 4, Jul-Aug 80 pp 151-159 manuscript received 26 Feb 79

OSADCHUK, V. A., L'vov

[Abstract] A method is proposed for evaluating the limiting equilibrium of shells with a system of cracks of arbitrary length within the framework of general moment theory. Expressions are found for the forces and moments in the shell that are caused by arbitrary distribution of the abrupt changes in displacements and the angles of turn along the cracks. Criteria of propagation are constructed for the longitudinal and transverse cracks in a closed cylindrical shell, using an energy approach based on the energy flux to the tip of the crack per unit of area of the crack. Numerical results are given. The author thanks Ya. S.

Podstrigach for constructive criticism and continued interest in the work. Figures 3, references 13: 9 Russian, 4 Western.
[112-6610]

UDC 539.384.4

STABILITY OF IRREGULARLY REINFORCED CYLINDRICAL SHELLS UNDER AXISYMMETRIC LOADING

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 4, Jul-Aug 80 pp 160-165 manuscript received 22 Feb 79

KABANOV, V. V. and KURTSEVICH, G. I., Novosibirsk

[Abstract] A method of stability calculation is proposed for a circular cylindrical shell of variable thickness reinforced by stringers and formers of variable stiffness. It is assumed that the shell is loaded by nonuniform external pressure and nonuniform linear compressive forces, and that the Kirkhoff-Love hypotheses are valid for the entire shell. A numerical algorithm is developed on the basis of a finite-difference method for investigating the stability of the shell under different boundary conditions. An example is given of analysis of the stability of a freely supported shell reinforced by formers of variable height under uniform lateral external pressure, under the combined action of uniform pressure and axial compression, and under variable pressure and compression. The effectiveness of nonuniform reinforcement is analyzed. Figures 3, references 4 Russian.
[112-6610]

UDC 539.374

PLASTIC DEFORMATION OF A CIRCULAR PLATE BY A LOAD IN THE FORM OF A DETONATION WAVE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 5, Sep-Oct 80 pp 93-99 manuscript received 31 Oct 78

YAKUPOV, R. G., Ufa

[Abstract] A circular plate of a still and ideally plastic isotropic material covers a dense medium in which a charge of explosive is detonated. The compression stress-strain diagram of the medium is described by a power law, the plate is either freely supported or clamped around its periphery. The motion of the plate under a medium or high pressure of the detonation wave is subdivided into four stages from the instant of impact, through acceleration to maximum velocity and contraction of the hinge circle, to the instant when wave motion in the medium ceases and then the motion of the plate ceases. The final deflection of the center of the plate is calculated as a function of the pressure

at the wave front during reflection from the plate and thus as a function of the charge thickness, also as a function of the distance from charge to plate relative to the charge mass. Numerical results are shown for a steel plate on sand with a flat charge of explosive underground. Figures 2; references 9: 6 Russian, 1 Polish, 2 Western.
[116-2415]

UDC 539.374

A CLASS OF INVERSE PROBLEMS INVOLVING ELASTOPLASTIC RESHAPING OF SHELLS

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 5, Sep-Oct 80 pp 116-123 manuscript received 31 Oct 78

BURLAKOV, A. V. and L'VOV, G. I., Kharkov

[Abstract] A class of inverse elastoplastic reshaping problems related to technological processes is to determine the action necessary for changing a thin shell with a given median surface to one with another given median surface. Topologically the set of points on the original surface is to be mapped uniquely onto the final surface. Assuming no tangential load components and only negligible changes in the shell thickness, the normal pressure and the three space components of the displacement vector are calculated from a system of equations describing the static-geometric state of a thin shell at equilibrium and the state of a plastic body. These equations involve covariant components of the strain tensor and contravariant components of the stress tensor. Generally a normal pressure alone is not sufficient for reshaping a shell, application of some moments and shearing forces at the edges is also necessary. The constraint on the cartesian coordinates of the displacement vector is, with very few exceptions, a nonlinear algebraic equation with respect to its components. The problem is solved here through linearization of the geometrical constraint and the resolvent nonlinear differential equations, assuming small per-unit elongations and twist angles, and linearization of the elastoplastic state by the method of additional strains. The algorithm is demonstrated on three practical cases: reshaping of a shallow cylindrical shell segment into a paraboloid, a circular plate into a spherical shell segment, and a cylindrical shell into a conical one. Numerical results have been obtained with the aid of a BESM-6 high-speed computer, linearization of the geometrical constraint requiring only 3-4 iterations and the method of additional strains requiring 9-14 iterations. Figures 6; references 10: 9 Russian, 1 Western.
[116-2415]

UDC 624,07:534,1

SYNCHRONIZATION OF HARMONIC FORCE GENERATORS ON A FREE SUPPORTING BEAM

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian No 5, Sep-Oct 80 pp 133-140 manuscript received 30 May 78

GUZEV, V. V. and NAGAYEV, R. F., Leningrad

[Abstract] A dynamic system is considered which consists of n identical harmonic force generators weakly coupled through a common supporting beam with free ends. Action of these generators is assumed to be normal to the beam and small vibrations of the latter do not dissipate energy. The generators are spaced uniformly with the beam extensions at both ends half as long as the distance between adjacent generators. The necessary and sufficient conditions of asymptotically stable cophased synchronism in this system are found from the characteristic system of n linear homogeneous algebraic equations, the n-1 roots of whose determinant must be negative. The harmonic influencing factors appearing in these equations are determined from the fourth-order differential equation of transverse vibrations of a free beam. The stability criteria are subsequently extended so as to also establish the frequency range of stable cophased synchronism. For material-moving machinery this range must overlap with the frequency range of transportability. In the case of harmonic torsion generators on a flexible beam such an overlap is possible only with n-5 generators, at all values of the mass distribution factor when n = 2 and only at higher values of this factor and within a narrower frequency range when the number n increases. The results of this analysis can be useful for the design of vibratory ore transporting and concentrating machines, as is demonstrated here in the case of a system with n generators acting obliquely but all at the same angle on a longitudinally rigid beam at one end of which a passive synchronizer consisting of a mass and a spring is attached for stabilization. Figures 4; references 6 Russian.
[116-2415]

UDC 539.3:629.7.024

FINITE-ELEMENT CALCULATION OF THINWALL REINFORCED SHELLS OF FUSELAGE TYPE CONSIDERING PHYSICAL NONLINEARITY AND LOSS OF STABILITY BY CERTAIN ELEMENTS

Yerevan IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: AVIATSIONNAYA TEKHNIKA in Russian No 2, 1980 pp 20-24 manuscript received 11 Mar 79

BURMAN, Z. I. and SHUVALOV, V. A.

[Abstract] Determination of the stress-strain state of thinwall aviation structures within limits of their linear deformation must be considered a first approximation, since high stress levels in these thinwall elements may lead to basically different types of work of the elements. The most important factors which change the nature of work of a structure include appearance of plasticity

in reinforcing elements and loss of stability by the thinwall skin within the limits of elasticity. Methods are studied for considering these factors and their influence on the stress-strain state of a fuselage. An iterational method is suggested in which an equation presented in the article is used to determine the additional external load after the linear deformation of the system is calculated, then the cycle is repeated until the difference in stresses in two successive approximations is less than a predetermined value. A calculation example is appended. Figures 2, References 8: 7 Russian, 1 Western.
[123-6508]

UDC 539.4:629.7.02

DESIGN OF WINGS BY A PLATE ANALOGY USING AN INTEGRAL-DIFFERENCE METHOD

Yerevan IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: AVIATSIONNAYA TEKHNIKA in Russian No 2, 1980 pp 25-29 manuscript received 6 Oct 77

VAKHITOV, M. B., SAFARIYEV, M. S. and KHALIULIN, V. I.

[Abstract] The plate analogy is widely used for the wings of modern aircraft. This analogy reduces determination of the stress-strain state to determination of the bending of the middle surface. Earlier works have developed the basic principles of an integral-difference method based on this analogy in which the shape of the desired bend need not be stated. This allows it to be used for the design of wings of complex shape and wings with heterogeneous attachment to the fuselage. This article summarizes these earlier works. Numerical and experimental results are compared. Figures 7, References 7: 5 Russian, 2 Western.
[123-6508]

UDC 539.4:629.7.02

AN ITERATIONAL METHOD OF DETERMINING THE MAXIMUM LOAD-BEARING CAPACITY OF AVIATION STRUCTURES

Yerevan IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: AVIATSIONNAYA TEKHNIKA in Russian No 2, 1980 pp 40-44 manuscript received 10 May 79

DENISOV, Yu. A., POPOV, Yu. G. and SIMONOVA, G. Sh.

[Abstract] An iterational method is suggested for determining the load-bearing capacity of aviation structures which can be easily run on a computer. No limitations as to type of structure or method of determination of stress-strain state are imposed. It is assumed that the characteristics of the load-bearing capacity of individual elements of the structure are known. The essence of the method is that the load-bearing capacity of a structure or its true strength is determined as the value of the fictitious load bearing capacity at the point

where the fictitious load-bearing capacity curve $P^f=f(P)$ crosses the straight line $y=P$, where P is the force, in percent of the design load, P^f is the fictitious load-bearing capacity in percent of the load. The iterational process converges rapidly, 5-12 iterations being sufficient for determination of the load-bearing capacity with an accuracy of 1% of the design load. Figures 3, References 4 Russian.
[123-6508]

UDC 539.3:629.7.02

PLANNING OF COMPOSITE CYLINDRICAL SHELLS OF MINIMUM MASS IN A SUPERSONIC GAS FLOW

Yerevan IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: AVIATSIONNAYA TEKHNIKA in Russian No 2, 1980 pp 62-66 manuscript received 7 Jul 78

KOSICHENKO, A. A., POCHTMAN, Yu. M. and RIKARDS, R. B.

[Abstract] A study is made of the problem of optimal planning of a composite multilayer cylindrical shell in a supersonic gas flow moving in the direction of the generatrix. The shell is considered to consist of unidirectionally reinforced orthotropic layers of reinforced plastic wound symmetrically at angles of $\pm\phi_k$ relative to the axis of the shell. A numerical illustration is presented. A shell constructed of layers wound in three difffrent directions is found to be essentially as strong as one made of layers wound in more than three different directions. Figure 1, Table 1, References 8: 6 Russian, 2 Western.
[123-6508]

UDC 539.4:629.7.02

ANALYSIS OF THE INFLUENCE OF ATMOSPHERIC TURBULENCE ON THE LEVEL OF VARIABLE BENDING STRESS IN THE BLADES OF THE LIFTING ROTOR OF A HELICOPTOR

Yerevan IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: AVIATSIONNAYA TEKHNIKA in Russian No 2, 1980 pp 83-86 manuscript received 23 Feb 79

TURKINA, A. I.

[Abstract] A method is suggested for calculating the bending stresses in the blades of the lifting rotor of a helicoptor considering its movement through a turbulent atmosphere. Calculation of the elastic bending oscillations is reduced to the solution of a system of differential equations. The equations are solved by a method in which the movement of the blades is found by numerical integration of ordinary differential equations obtained from the initial system by the method of Galerkin. The equations are interconnected only by aerodynamic forces. It is found that as the altitude of flight of the helicopter increases, the influence

of instability in the air decreases somewhat, while as the flight speed increases, the stresses increase significantly. Figures 4, References 4 Russian.
[123-6508]

UDC 539.3:534.1

ESTIMATE OF THE FREQUENCY OF OSCILLATION OF PLATES AND SHELLS CARRYING A SHOCK-MOUNTED MASS

Yerevan IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: AVIATSIONNAYA TEKHNIKA in Russian No 2, 1980 pp 89-93 manuscript received 26 Apr 78

ANDREYEV, L. V., DYSHKO, A. L. and PAVLENKO, I. D.

[Abstract] Approximate equations are found for estimation of the natural frequency throughout the entire range of change of parameters of an attached oscillator. Simple "load-bearing surface plus damped mass" models are used in the solution. The problem requires consideration both of the local rigidity of the shell or plate at the point of attachment of the mass and of the dynamic properties of the entire load-bearing surface. Several approximate approaches are suggested and the region of applicability of simplified models is determined. The approximate equations suggested yield estimates which are close to exact solution over a broad range of change of parameters of the attached mass. Figures 3, References 4 Russian.
[123-6508]

UDC 539.3:534.1

CERTAIN EFFECTS ARISING IN STUDIES OF THE STABILITY OF OPEN RIBBED CYLINDRICAL SHELLS

Yerevan IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: AVIATSIONNAYA TEKHNIKA in Russian No 2, 1980 pp 93-96 manuscript received 10 Jun 78

KAN, S. N., KAPLAN, [illegible] I. and PAKOVA, N. V.

[Abstract] The problem of loss of stability occuring as a result of bifurcation of the subcritical equilibrium state is studied for open ribbed cylindrical shells, considering eccentricity and rigidity of the ribs and twisting. The shells are loaded in pure bending, and the initial state is assumed to be a zero-moment state. Consideration of the rigidity of the ribs in torsion increases the critical stresses and the moment of loss of stability by more than 30%. Table 1, References 2 Russian.
[123-6508]

UDC 539.4:621.81

DESIGN OF MULTILAYERED AND HETEROGENEOUS CYLINDERS USING STEP FUNCTIONS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian
No 8, 1980 pp 5-8 manuscript received 22 May 78

BYRKE, M. S.

[Abstract] A convenient method is developed for the design of multilayer cylinders with large numbers of layers and estimates are produced of the accuracy of approximate solutions for continuous heterogeneous cylinders. The method suggested is based on the use of step functions such as the Heaviside function. A hollow isotropic multilayered cylinder is studied, loaded under planar deformation conditions with uniform pressures on the inside and outside surfaces. It is assumed that the layers have different moduli of elasticity, identical Poisson's ratio and are fully bonded to each other. Numerical examples are used to illustrate the possibility of development of compressive stresses in the cylinder under certain conditions. Table 1, Figures 2, References 7 Russian.
[105A-6508]

UDC 539.3

NATURAL OSCILLATIONS OF A CYLINDRICAL SHELL WITH A HETEROGENEOUS ELASTIC FILLER

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian
No 8, 1980 pp 38-42 manuscript received 29 Jun 78

POZHUYEV, V. I., candidate of technical sciences

[Abstract] A study is made of the problem of the natural axisymmetrical oscillations of a cylindrical shell containing a filler which has weight, is heterogeneous through its thickness and has one central channel. The problem is solved using a method based on approximate solution of the boundary-value problem by the method of orthogonal trials. The influence that variations in the modulus of elasticity and density of the filler have on the frequency of oscillations is studied. The method permits computerized calculation for arbitrary variation in Young's modulus and density, including discrete changes (multilayered filler). Figures 3, References 5 Russian.
[105A-6508]

UDC 621.983.044.7

COMPRESSION OF A THINWALL CYLINDRICAL TUBE IN AN ANNULAR SLOT

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: MASHINOSTROYENIYE in Russian No 8, 1980 pp 111-114 manuscript received 22 Dec 78

YAKOVLEV, S. P., doctor of technical sciences, professor KUKHAR', V. D., candidate of physical and mathematical sciences, assistant and TALALAYEV, A. K., graduate student

[Abstract] A study is made of the problem of squeezing of a thinwall pipe in an annulus by a pulsed magnetic field. It is assumed that the anisotropic material of the pipe is rigid-plastic, orthotropic, and experiences strain hardening, and that the Mises-Hill flow condition is applicable. The stress and strain as well as the change of electromagnetic force, velocity and magnitude of displacement of the central portion of the shell are all studied. The movement of the shell is found to begin only after a delay with respect to the beginning of the discharge. The process has significant inertia. Figures 3, References 2 Russian.
[105A-6508]

UDC 621.752

DECREASE IN SPATIAL VIBRATION OF MECHANISMS OF AN ACTIVE VIBRATION-PROTECTION SYSTEM

Moscow MASHINOVEDENIYE in Russian No 5, Sep-Oct 80 pp 20-27 manuscript received 10 Sep 79

YELEZOV, V. G. and ZAYKOVA, I. G., Moscow

[Abstract] A study is made of the stability and effectiveness of a three-dimensional active vibration-protection system which decreases vibration forces acting on the body of a rotor mechanism through its bearings. Analysis of the system of curves of stability indicates that the boundaries of stability have two minima for values of $\Omega_v \approx 1.2$ and 2.45. The use of the wide-band vibration-protection system here analyzed is most effective for structures, the natural frequencies of which are not widely separated. This is not a departure from previous recommendations for the design of such systems. The parameters of vibration exciters should be selected so that the first frequency of the suspension of their reactive masses is significantly lower than the eigenfrequency of the initial elastic vibration-isolation system. Figures 5, References 5 Russian.
[109-6508]

UDC 539.3:534.1

HIGH FREQUENCY LONG-WAVE OSCILLATIONS OF SHELLS

Moscow PRIKLADNAYA MATEMATIKA I MAKHANIKA in Russian Vol 44, No 4, Jul-Aug 80
pp 737-744 manuscript received 3 May 79

BERDICHEVSKIY, V. L., Moscow and LE KHAN' CHAU, Hanoi

[Abstract] Long-wave oscillations refer to those produced by a stress state, the characteristic scale of changes of which is significantly greater than the thickness of the shell. This article presents a derivation of equations which describe this type of oscillation of shells. All long-wave oscillations can be represented as sums of oscillations corresponding to various branches. A variational-asymptotic method is used to derive two-dimensional equations for all branches. It is found that in the first approximation, the branches are all orthogonal in terms of elastic and kinetic energies. This means that in the first approximation oscillations of one type do not cause oscillations of any other type, making it possible to study the oscillations of any one branch independently of the others. References 6 Russian.
[106-6508]

UDC 539.375:534.1

THE VIBRATION OF A CIRCULAR CRACK UNDER A THREE-COMPONENT LOAD

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 44, No 5, Sep-Oct 80
pp 857-866 manuscript received 5 Jun 79

BABESHKO, V. A. and TKACHEV, G. V., Rostov-na-Donu

[Abstract] A study is made of a crack which is circular in plan in an elastic layer which is oscillating harmonically. The boundary-value problem, described by a system of three differential equations with the corresponding boundary conditions, is reduced by the method of integral transforms to the solution of a system of three integral equations for the unknown vector of the difference in movements of the upper and lower boundaries of the crack. The problem is further reduced to a system of two integral equations plus an independent equation, regularized by factoring of functions. The Institute of Mechanics and Applied Mathematics of Rostov State University has written computer programs which can be used to approximate the matrices, factor them and calculate the characteristics of a crack, the sides of which oscillate hormonically. These programs were used to calculate the dynamic stress intensity factor at the tip of a crack for a perpendicularly oscillating load applied to its sides. Figure 1, References 10: 8 Russian, 2 Western.
[120-6508]

UDC 539.3:534.1

THE ASYMPTOTIC THEORY OF BUCKLING OF ELASTIC PLATES UPON LATERAL COMPRESSION

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 44, No 5, Sep-Oct 80
pp 882-891 manuscript received 4 Feb 80

RUDEV, A. N., Pukov

[Abstract] A study is made of a plate consisting of an incompressible material subjected to uniform pressure along its lateral surfaces. It is assumed that the plate is not clamped, that its ends are unloaded, and that there are no mass forces present. The deformation arising in the plate is calculated. It is found that for thin plates, the irregular potential solutions have very little influence on the critical force or stress-strain state of the plate. The most important term in the asymptotic critical load as ε approaches 0 is determined by the penetrating solution alone. The first two corrections to the classical theory depend also on the vortex solution. Potential solutions corresponding to the regular portion of the spectrum influence only the third and later corrections. References 9 Russian.
[120-6508]

UDC 539.3:534.4

INFLUENCE OF INITIAL IMPERFECTIONS ON BULGING OF ELASTIC SHELLS WITH MULTIPLE CRITICAL LOADS

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 44, No 5, Sep-Oct 80
pp 893-904 manuscript received 19 Jun 79

SRUBSHCHIK, L. S., Rostov-na-Donu

[Abstract] The system of nonlinear equations of equilibrium of elastic shells with slight initial irregularities in the form of the mean surface is presented. The equations are analyzed together with each of the boundary conditions on the contour. Asymptotic representations of new equilibria in the post-critical stage are constructed, and equations for the surfaces of critical modes as functions of the parameters of shell defects are generated. It is shown that consideration of the connectedness of natural forms significantly reduces the maximum critical pressure. Figure 1, References 23: 11 Russian, 12 Western.
[120-6508]

UDC 539.383

SOME DYNAMIC AND STATIC CONTACT PROBLEMS OF THE THEORY OF ELASTICITY FOR A CIRCULAR CYLINDER OF FINITE SIZE

Moscow PRIKLADNAYA MATEMATIKA I MEKHANIKA in Russian Vol 44, No 5, Sep-Oct 80 pp 923-933 manuscript received 9 Jan 80

CHEBAKOV, M. I., Rostov-na-Donu

[Abstract] A study is made of an elastic layer, the boundaries of which are immobile and free of stresses, or one of which is immobile while the other is free of stresses. The method of homogeneous solutions is used to solve these problems. A numerical example is presented. The problems are modeled by the axisymmetrical contact problem of vertical nonresonant oscillations of a punch resting without friction on the flat boundary of a circular cylinder under the influence of vertical force and the axisymmetrical contact problem of nonresonant twisting oscillations of a punch rigidly coupled to the flat boundary of a circular cylinder under the influence of torque. Figure 1, References 16 Russian.
[120-6508]

UDC 524.074.4:531.3

STABILITY OF A CYLINDRICAL SHELL WITH HETEROGENEOUS NONAXISYMMETRICAL LOADING

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 16, No 8, Aug 80 pp 11-15 manuscript received 13 Mar 78

KABANOV, V. V. and MIKHAYLOV, V. D., Novosibirsk

[Abstract] A study is made of a circular cylindrical shell loaded on the side surface with a heterogeneous external pressure. The problem is solved by dividing the dimensionless length of this shell into a number of equal intervals and writing the vector-matrix in finite-difference form. The equation thus produced is then supplemented with boundary conditions. The Gaussian matrix method of elimination is then used to reduce the system to a block-diagonal form, thus producing a determinant in the form of a product. The zeros of the determinant correspond to the critical loads. This algorithm can be used to determine the critical load under arbitrary conditions at the ends of the shell. The algorithm has been used to write a computer program for a BESM-6 computer. Figures 5, References 8: 7 Russian, 1 Western.
[107-6508]

UDC 539.3

GEOMETRICALLY NONLINEAR DEFORMATION OF SOFT SHELLS WITH ASYMMETRICAL LOAD

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 16, No 8, Aug 80 pp 16-23 manuscript received 26 Jun 79

KAYUK, Ya. F. and VASHCHENKO, L. F., Institute of Mechanics, Ukrainian Academy of Sciences, Kiev

[Abstract] A soft, conical shell of revolution is studied under internal pressure produced by compressed air. The ends of the shell are rigidly fixed. It is further assumed that the soft shell is exposed to a wind load. An iterational method is used to calculate the change in shape of the shell in various cross sections through its height for a wind speed of 20 m/s and internal pressure of 0.1 MPa. Geometric nonlinearity is found to have a significant influence both on the kinematic quantites and on the forces applied. Calculations based on linear theories may yield significant errors in this case. Figures 4, References 3 Russian.
[107-6508]

UDC 539.3

THE PROPAGATION OF LONGITUDINAL WAVES IN A PRESTRESSED COMPRESSIBLE CYLINDER CONTAINING A FLUID

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 16, No 8, Aug 80 pp 24-29 manuscript received 29 Feb 80

BAGNO, A. M., Institute of Mechanics, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] A study is made of an infinitely long isotropic compressible hollow circular cylinder in a homogeneous initial state of deformation. An ordinary differential equation is derived to study the propagation of axisymmetrical waves in the cylinder. This equation is converted to a system of four linear homogeneous algebraic equations. Assuming that a nontrivial solution exists, a dispersion equation is derived to describe the propagation of axisymmetrical waves in the cylinder. This equation was solved numerically on an M-4030 computer by an iterational method. Figures 2, References 9: 8 Russian, 1 Western.
[107-6508]

UDC 539.3

THE DYNAMIC INSTABILITY OF GLASS-REINFORCED PLASTIC SHELLS CARRYING CONCENTRATED MASSES

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 16, No 8, Aug 80 pp 42-47 manuscript received 18 Jan 80

GALAKA, P. I., KOVAL'CHUK, P. S., MENDELUTSA, V. M. and NOSACHENKO, A. M., Institute of Mechanics, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] An experimental study is presented of some features of parametrically excited oscillations of glass-reinforced plastic shells carrying a concentrated mass. Primary attention is given to the study of the behavior of the shell-mass system in the region of dynamic instability, particularly in the region of the main parametric resonance, when the dynamic bending of the shell is significant, i.e., much greater than the thickness of the shell. The experimental studies were performed on shells made by longitudinal and transverse lamination in two layers using epoxy resin, Bakelite varnish and type BF-4 cement as the binder. The shells were cured at 423 K for 30 hr. The results indicate that attached masses (even very light in comparison to the mass of the shell) have a great influence on the dynamic characteristics of the shells, as well as the region of dynamic instability. Table 1, Figures 6, References 11 Russian.
[107-6508]

UDC 539.3

THE STRESS STATE OF THICKWALL SHELLS OF REVOLUTION UNDER NONUNIFORM THERMAL LOADING

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 16, No 8, Aug 80 pp 116-119 manuscript received 8 Jun 79

VLAYKOV, G. G., Institute of Mechanics, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] A study is made of the deformation of thickwall orthotropic shells of revolution of constant thickness under the influence of thermal loads which are nonuniform in all directions. The problem is solved by replacement of the three-dimensional problem of the theory of elasticity with a sequence of one-dimensional boundary-value problems by expansion of the functions fixed and sought into Fourier series with respect to the circumferential coordinate and application of a stable numerical method of discrete orthogonalization. The distribution of the load along the generatrix largely determines the distribution of the component of the stress-strain state along the coordinate. Figures 3, Table 1, References 3 Russian.
[107-6508]

UDC 539.3

THE INFLUENCE OF SHEAR DEFORMATIONS ON THE CRITICAL EXTERNAL PRESSURE OF A SPHERICAL SHELL

Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 16, No 8, Aug 80 pp 119-122 manuscript received 3 Dec 79

GRACHEV, O. A., Institute of Mechanics, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] A solution is presented to the problem of stability of a spherical shell under the influence of an external uniformly distributed pressure. The solution is achieved using an energy method in a form which is convenient to use in the analysis of stability of ribbed spherical shells. The solution is based on a refinement of the theory of thin shells. By using the transverse shear modulus, the critical pressure parameter is reduced in comparison to that calculated by the classical theory by 2% (for $R/h=100$) to 39% (for $R/h=10$). The influence of shear deformation is thus significant for shells with low shear modulus where $R/h < 100$. Figure 1, References 9: 8 Russian, 1 Western.
[107-6508]

UDC 621.643:4.062:539.3

STRESSES AND DEFORMATIONS OF THIN-WALL OVAL PIPES UNDER INTERNAL PRESSURE UNDER CONDITIONS OF CREEP

Kiev PROBLEMY PROCHNOSTI in Russian No 9, 1980 pp 22-24 manuscript received 10 Dec 79

ZVER'KOV, B. V. and DANYUSHEVSKIY, I. A., Central Scientific Research, Planning and Design Boiler and Turbine Institute imeni I. I. Polzunov

[Abstract] The steady state creep of a thin-wall oval tube is examined within the framework of small geometric deviations, but with no constraints on the smallness of additional stresses and strains. Local stresses in an oval tube are determined in consideration of their redistribution under creep conditions for the purpose of forecasting the relative durability of circular and oval pipes and for refining the parameters that determine the rate of change of the oval cross section. The shape factor is used as a small parameter. Expressions are found for the annular and radial forces and for the moment in an arbitrary cross section. Relations are found for circumferential, axial and radial normal stresses for a long tube under internal pressure. The typical pattern of the change in time of ovality under steady state creep conditions is plotted. The rate of change of ovality is found to be independent of the initial ovality. The result may be used for comparative analysis of the durability of circular and oval boiler tubes and steam pipes. Figures 3; references 4: 2 Russian, 2 Western.
[104-7872]

UDC 621.785:539.319

THERMOPLASTIC HARDENING OF LOCK PART OF THE RUNNER IN A GAS TURBINE ENGINE. DETERMINATION OF RESIDUAL STRESSES

Kiev PROBLEMY PROCHNOSTI in Russian No 9, 1980 pp 54-56 manuscript received 7 May 79

KRAVCHENKO, B. A., GUTMAN, G. N., BATRIN, L. Ye. and FOKIN, V. G., Kuybyshev Polytechnical Institute imeni V. V. Kuybyshev

[Abstract] The thermoplastic hardening of the turbine runner keyway is examined on special simulated runners in an effort to increase the reliability of turbine parts that operate in the combustion zone. Specimens are subjected to local heating near the bottom of the groove by rf currents to a given temperature and then are cooled rapidly with streams of water to normal temperature. The experimental setup and conditions are described and illustrated and graphs of strains and residual stresses are plotted. Residual compressive stresses are found to be one of the chief factors of thermoplastic hardening that impoove the durability of turbine parts. Figures 5; references: 3 Russian.
[104-7872]

UDC 621.165-226.001.24

STRENGTH ANALYSIS OF SECTIONAL DIAPHRAGMS OF STEAM TURBINES

Kiev PROBLEMY PROCHNOSTI in Russian No 9, 1980 pp 57-59, 63 manuscript received 27 Feb 80

BILAN, V. N.

[Abstract] Because new design solutions are needed for the development of the main assemblies and parts of 500 MW wet steam central heating turbines, and because new programs are necessary for calculating the strength of diaphragms with new requirements on speed in connection with the development of automatic turbine design systems, the author presents a theoretical substantiation of stress and bearing plans for series production. Each diaphragm manufactured at a plant is subjected to tests for the purpose of quality control and for comparing experimental and calculated sags at characteristic points. The maximum stresses and sags for half-ring plates of different sizes are given. The influence that the fastening of the rim to discrete bearing points has on the diaphragm stress state is examined and diaphragm sag on 4-12 discrete mounts is compared with the case of a continuous rim bearing surface. The temperature differential across the diaphragm does not cause stresses in the blades, rim and body, but causes the diaphragm to sag nearly axisymmetriallly. Mounting the diaphragm on the inside of the turbine housing substantially reduces stress and sag and provides a larger margin of strength. The discrete arrangement of reinforcing ribs in the diaphragm

is examined. The influence that the pliancy of welds between the rim and housing has on the diaphragm stress state is analyzed and sag is found usually not to exceed 10-20% of the theoretical sag for an absolutely rigid weld. Figures 2; tables 5; references: 4 Russian.
[104-7872]

TESTING AND MATERIALS

UDC 621.923.6.025.034.018.25

TREATMENT OF CUTTING TOOLS MADE OF SUPERHARD MATERIALS

Moscow MASHINOSTROITEL' in Russian No 10, Oct 80 pp 23-24

NIKOLAYEV, V.A., candidate of technical sciences

[Abstract] Precision machining of parts requires cutting tools of superhard materials with a high thermal conductivity. Diamond tools are particularly suitable for this purpose, but the high cost of diamond single crystals makes other materials such as leucosapphire and ruby as well as synthetic diamond powders also attractive. A study made at the Belorussian Polytechnic Institute has established that the physico-chemical properties of a tool material predetermine its range of applications. Thus natural and synthetic diamonds should be used for cutting nonferrous metals and alloys as well as hard alloys, leucosapphire and ruby single crystals should be used for cutting nonferrous metals and sintered antifriction materials on an iron base, and cutters made of boron nitride ("Elbor-R", "Hexanite-R") should be used for machining hardened materials. The two important requirements for successful machining are proper and rigid mounting of the cutter to ensure reliability and adequate smoothness of the working surfaces to ensure long service. It is advisable to sharpen and finish stepwise from rough to fine, without skipping any of the intermediate passes. Figures 1.
[115-2415]

UDC 534.282:62-752:620.178.311.6

INCREASING THE VIBRATIONAL RELIABILITY OF STRUCTURAL ELEMENTS BY DAMPING THEIR VIBRATIONS

Kiev PROBLEMY PROCHNOSTI in Russian No 10, Oct 80 pp 6-16 manuscript received 16 Apr 80

MATVEYEV, V. V., Institute of Strength Problems, UkSSR Academy of Sciences, Kiev

[Abstract] The damping characteristics of structural materials for such elements as turbine blades were systematically studied at the Institute of strength problems under the direction of Academician G. S. Pisarenko (member, Academy

of Sciences of the Ukrainian SSR). The materials included steels 1Kh12N2VMF (grade EI961) and grade EI696M, whose damping characteristics are excellent because of magnetomechanical hysteresis, also a few other chromium steels and an aluminum alloy. Measured were flexural and transverse vibrations, their amplitude-frequency characteristics, dependence of the amplitude decrement on the heat treatment (tempering) temperature and on the level of static tensile stresses, also effects of coating films and of banding. Here the experimental data are correlated with and evaluated on the basis of theoretical energy and power-law relations. The results are then applied to reliability estimates according to the most objective criterion of vibration resistance. Figures 11; table 1; references 37 Russian.
[121-2415]

UDC 539.4.013:62-226.2

CARRYING CAPACITY OF ELEMENTS OF TURBINE RUNNERS

Kiev PROBLEMY PROCHNOSTI in Russian No 10, Oct 80 pp 133-137 manuscript received 8 May 80

KOZLOV, I. A., Institute of Strength Problems, UkSSR Academy of Sciences, Kiev

[Abstract] The carrying capacity of turbine elements at very low and very high temperatures is an important consideration on which further developments in power equipment hinge. Methods and instrumentation have been developed at the Institute of Strength Problems for evaluation of runner design and performance under such conditions. They include an automatically operating and controlled cryogenic test chamber with liquid-nitrogen cooling and induction heating, also conical shell and flat experimental models for stress and strain measurements, bimetal specimens of runner elements, also analytical models for calculations based on the theory of small elastoplastic strains and with blades made of chromium-nickel steels and aluminum alloys, appreciably stronger but not proportionally more elastic at low temperatures than low-carbon steel and copper. Test procedures for reliability studies include microstructural analysis as well as starting, running, and load cycling. Tables 1; references 29 Russian.
[121-2415]

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